

## Claims

- [1] An end seal having:  
a front defining an outward direction,  
a leading edge defining a downward direction, and  
a trailing edge opposite the leading edge,  
the end seal comprising a first lip, a second lip, and a third lip, each lip elongated  
and extending toward the leading edge and toward the trailing edge,  
each lip having a portion having a radius of curvature about a respective center;  
the second lip disposed between the first lip and the third lip;  
the center of radius of curvature of the second lip offset from the center of radius  
of curvature of the first lip; and  
the center of radius of curvature of the second lip offset from the center of radius  
of curvature of the third lip.
- [2] The end seal of claim 1 wherein the center of radius of curvature of the first lip is  
coaxial with the center of radius of curvature of the third lip.
- [3] The end seal of claim 1 wherein the first and third lips join toward the trailing  
edge.
- [4] The end seal of claim 1 wherein the end seal comprises PTFE.
- [5] The end seal of claim 1 further comprising a first spring means urging the end  
seal outwards.
- [6] The end seal of claim 5 further comprising a second spring means urging the end  
seal outwards.
- [7] An end seal having:  
a top defining an outward direction,  
a leading edge defining a downward direction, and  
a trailing edge opposite the leading edge,  
the end seal comprising a first lip, a second lip, and a third lip, each lip elongated  
and extending toward the leading edge and toward the trailing edge,  
the second lip disposed between the first lip and the third lip;  
wherein the first and third lips join toward the trailing edge.
- [8] The end seal of claim 7 wherein each lip has a portion having a radius of  
curvature about a respective center;  
the center of radius of curvature of the second lip is offset from the center of  
radius of curvature of the first lip; and  
the center of radius of curvature of the second lip is offset from the center of  
radius of curvature of the third lip.
- [9] The end seal of claim 7 wherein each lip has a portion having a radius of  
curvature about a respective center; and  
wherein the center of radius of curvature of the first lip is coaxial with the center  
of radius of curvature of the third lip.

- [10] The end seal of claim 7 wherein the end seal comprises PTFE.
- [11] The end seal of claim 7 further comprising a first spring means urging the end seal outwards.
- [12] The end seal of claim 11 further comprising a second spring means urging the end seal outwards.
- [13] An apparatus comprising:  
 an elongated nozzle having an elongated opening defined along its length by a flexible back seal and a metering surface defined with respect to an upward direction of travel of a substrate or roll past the elongated opening, the substrate or roll having a width, the direction of travel such that the substrate or roll first encounters the flexible back seal and later encounters the metering surface, the elongated opening having first and second ends separated by a distance, the distance less than the width of the substrate or roll; the nozzle defining a back direction away from the substrate or roll and a front direction toward the substrate or roll;  
 a first end seal at the first end;  
 a second end seal at the second end;  
 the first seal comprising first, second, and third lips each extending in the direction of travel and each having an edge in the direction of the substrate or roll;  
 the second seal comprising first, second, and third lips each extending in the direction of travel and each having an edge in the direction of the substrate or roll;  
 the first lips of the first and second seals disposed toward each other;  
 the third lips of the first and second seals disposed away from each other;  
 the second lip of the first seal disposed between the first and third lips of the first seal;  
 the second lip of the second seal disposed between the first and third lips of the second seal;  
 the first and third lips of the first seal joined together at top ends thereof;  
 the first and third lips of the second seal joined together at top ends thereof;  
 the edges of the first and third lips of the first and second seals shaped to fit the substrate or roll.
- [14] The apparatus of claim 13 wherein each lip has a portion having a radius of curvature about a respective center;  
 the center of radius of curvature of the second lip is offset from the center of radius of curvature of the first lip; and  
 the center of radius of curvature of the second lip is offset from the center of radius of curvature of the third lip.
- [15] The end seal of claim 13 wherein each lip has a portion having a radius of

curvature about a respective center; and  
 wherein the center of radius of curvature of the first lip is coaxial with the center  
 of radius of curvature of the third lip.

- [16] The apparatus of claim 13 wherein:  
 the first end seal is mounted to the nozzle by means of a flexible bracket; and  
 the second end seal is mounted to the nozzle by means of a flexible bracket.
- [17] The apparatus of claim 13 further comprising coating fluid under a first pressure  
 through the nozzle toward the substrate or roll;  
 the shape of the first end seal chosen to give rise to a second pressure of the  
 coating fluid within a pocket defined by the first and third lips of the first seal,  
 the second pressure less than the first pressure;  
 the shape of the second end seal chosen to give rise to a third pressure of the  
 coating fluid within a pocket defined by the first and third lips of the second seal,  
 the third pressure less than the first pressure.
- [18] The apparatus of claim 13 further comprising a drip pan positioned below the  
 first end seal and below the second end seal.
- [19] An apparatus comprising:  
 an elongated nozzle having an elongated opening defined along its length by a  
 flexible back seal and a metering surface defined with respect to an upward  
 direction of travel of a substrate or roll past the elongated opening, the substrate  
 or roll having a width, the direction of travel such that the substrate or roll first  
 encounters the flexible back seal and later encounters the metering surface, the  
 elongated opening having first and second ends separated by a distance, the  
 distance less than the width of the substrate or roll; the nozzle defining a back  
 direction away from the substrate or roll and a front direction toward the  
 substrate or roll;  
 a first end seal at the first end;  
 a second end seal at the second end;  
 the first seal comprising first, second, and third lips each extending in the  
 direction of travel and each having an edge in the direction of the substrate or  
 roll;  
 the second seal comprising first, second, and third lips each extending in the  
 direction of travel and each having an edge in the direction of the substrate or  
 roll;  
 the first lips of the first and second seals disposed toward each other;  
 the third lips of the first and second seals disposed away from each other;  
 the first and third lips of the first seal joined together at top ends thereof;  
 the first and third lips of the second seal joined together at top ends thereof;  
 the second lip of the first seal disposed between the first and third lips thereof;  
 the second lip of the second seal disposed between the first and third lips thereof;

- the edges of the first and third lips of the first and second seals shaped to fit the substrate or roll;  
the first end seal mounted to the nozzle by means of a flexible bracket; and  
the second end seal mounted to the nozzle by means of a flexible bracket.
- [20] The apparatus of claim 19 further comprising a drip pan positioned below the first end seal and below the second end seal.
- [21] The apparatus of claim 19 wherein each lip has a portion having a radius of curvature about a respective center;  
the center of radius of curvature of the second lip is offset from the center of radius of curvature of the first lip; and  
the center of radius of curvature of the second lip is offset from the center of radius of curvature of the third lip.
- [22] The apparatus of claim 19 wherein each lip has a portion having a radius of curvature about a respective center; and  
wherein the center of radius of curvature of the first lip is coaxial with the center of radius of curvature of the third lip.
- [23] Apparatus comprising a first nozzle and a return funnel, the apparatus positioning the first nozzle and the return funnel relative to an applicator roll or web,  
the first nozzle comprising an slot elongated along a first axis, the slot defined by a flexible back seal elongated along the first axis and by a metering surface elongated along the first axis, the back seal and metering surface defining a first plane parallel with the first axis;  
the slot disposed in osculation with the applicator roll or web along a line;  
the apparatus comprising means by which the first nozzle may be fixed at any of a plurality of orientations so that the first plane is at any of a plurality of respective angles of rotation about the first axis.
- [24] The apparatus of claim 23 wherein the plurality of orientations comprises a continuously adjustable range of orientations.
- [25] The apparatus of claim 23 wherein the plurality of orientations extends through an approximate ten-degree range of angle of rotation of the first plane.
- [26] The apparatus of claim 23 wherein the apparatus comprises means causing the the return funnel to follow the slot angle.
- [27] An apparatus comprising:  
an elongated nozzle having an elongated opening defined along its length by a flexible back seal and a metering surface defined with respect to an upward direction of travel of a substrate or roll past the elongated opening, the substrate or roll having a width, the direction of travel such that the substrate or roll first encounters the flexible back seal and later encounters the metering surface, the elongated opening having first and second ends separated by a distance, the

distance less than the width of the substrate or roll; the nozzle defining a back direction away from the substrate or roll and a front direction toward the substrate or roll;

a first end seal at the first end;

a second end seal at the second end;

the first seal comprising a first lip extending in the direction of travel having an edge in the direction of the substrate or roll and having a first end toward the back seal and a second end toward the metering surface;

the second seal comprising a first lip extending in the direction of travel having an edge in the direction of the substrate or roll and having a first end toward the back seal and a second end toward the metering surface;

the edge of the first lip of the first and second seals shaped to fit the substrate or roll;

the first end seal pivotable about a first pivot point between first end and the second end thereof;

the second end seal pivotable about a second pivot point between first end and the second end thereof;

the first pivot point and the second pivot point each biased in the front direction.

[28] The apparatus of claim 27 further comprising a drip pan positioned below the first end seal and below the second end seal.

[29] The apparatus of claim 27 further comprising a first spring urging the second end of the first lip in the front direction, and a second spring urging the second end of the second lip in the front direction.

[30] The apparatus of claim 27 wherein the nozzle is rotatable about an axis parallel to the elongated opening, the apparatus comprising means by which the nozzle may be fixed at any of a plurality of respective angles of rotation about the first axis.

[31] An apparatus comprising:

an elongated nozzle having an elongated opening defined along its length by a flexible back seal and a metering surface defined with respect to an upward direction of travel of a substrate or roll past the elongated opening, the substrate or roll having a width, the direction of travel such that the substrate or roll first encounters the flexible back seal and later encounters the metering surface, the elongated opening having first and second ends separated by a distance, the distance less than the width of the substrate or roll; the nozzle defining a back direction away from the substrate or roll and a front direction toward the substrate or roll;

a first end seal at the first end;

a second end seal at the second end;

the first seal comprising a first lip extending in the direction of travel and having

an edge in the direction of the substrate or roll;  
 the second seal comprising a first lip extending in the direction of travel and having an edge in the direction of the substrate or roll;  
 the edges of the first lips of the first and second seals shaped to fit the substrate or roll;

the first end seal mounted to the nozzle by means of a flexible bracket;  
 the second end seal mounted to the nozzle by means of a flexible bracket;  
 wherein the nozzle is rotatable about an axis parallel to the elongated opening, the apparatus comprising means by which the nozzle may be fixed at any of a plurality of respective angles of rotation about the first axis.

[32] An end seal for sealing each end of a cavity consisting of a leading edge and a metering surface for application of a liquid having:  
 a front defining an outward direction toward the application surface;  
 a leading edge defining the area of first contact with the application surface; and  
 a trailing edge opposite the leading edge;  
 the end seal comprising a lip that approximately conforms to the application surface;  
 a spring supporting the end seal between the leading edge and the trailing edge from under the end seal toward the application surface.

[33] The end seal of claim 32 wherein the end seal spring support point is a pivot.

[34] The end seal of claim 32 wherein the end seal has a spring support under the trailing edge of the end seal.

[35] The end seal of claim 33 wherein the end seal has a spring support under the trailing edge of the end seal.

[36] An end seal for sealing each end of a cavity consisting of a leading edge and a metering surface for application of a liquid having:  
 a front defining an outward direction toward the application surface;  
 a leading edge defining the area of first contact with the application surface; and  
 a trailing edge opposite the leading edge;  
 the end seal comprising two lips that approximately conforms to the application surface elongated and extending towards the leading edge and toward the trailing edge;  
 the two lips joining toward the trailing edge; and  
 wherein a spring supports the end seal between the leading edge and the trailing edge from under the end seal toward the application surface.

[37] The end seal of claim 36 wherein the end seal spring support is a pivot.

[38] The end seal of claim 36 wherein the end seal has a spring support under the trailing edge of the end seal.

[39] The end seal of claim 37 wherein the end seal has a spring support under the trailing edge of the end seal.

- [40] An end seal for sealing each end of a cavity consisting of a leading edge and a metering surface for application of a liquid having:  
 a front defining an outward direction toward the application surface;  
 a leading edge defining the area of first contact with the application surface;  
 a trailing edge opposite the leading edge;  
 the end seal composing a lip that approximately conforms to the application surface;  
 a support mounting location beyond the leading edge; and  
 a thin cross-section between the mounting location and the leading edge creating a flex point permitting deformation along the seal lips.
- [41] 41) An end seal for sealing each end of a cavity consisting of a leading edge and a metering surface for application of a liquid, the end seal comprising:  
 a front defining an outward direction toward the application surface;  
 a leading edge defining the area of first contact with the application surface;  
 a trailing edge opposite the leading edge;  
 the end seal composing two lips that approximately conform to the application surface and extending toward the leading edge and toward the trailing edge and joining toward the trailing edge;  
 a support mounting location beyond the leading edge; and  
 a thin cross-section between the mounting location and the leading edge creating a flex point permitting deformation along the seal lips.
- [42] An end seal for sealing each end of a cavity consisting of a leading edge and a metering surface for application of a liquid, the end seal comprising:  
 a front defining an outward direction toward the application surface;  
 a leading edge defining the area of first contact with the application surface;  
 a trailing edge opposite the leading edge;  
 the end seal composing a first lip, a second lip, and a third lip, each lip elongated and extending toward the leading edge and toward the trailing edge and approximate conformity to the application surface;  
 the first and third lip join toward the trailing edge;  
 the second lip disposed between the first lip and the third lip;  
 the center of radius of curvature of the second lip is offset from the center of curvature of the first lip;  
 a support mounting location beyond the leading edge;  
 a thin cross-section between the mounting location and the leading edge creating a flex point permitting deformation along the seal lips.
- [43] An apparatus comprising:  
 one or more elongated nozzles consisting of a leading edge, a metering surface and end seals having an elongated opening that deposits coating to an application surface;

a return trough for the active nozzle to collect undeposited coating back for recycling;

a return funnel for collecting undeposited coating from the return trough for return to the coating tank for recycling.

[44] The apparatus of claim 43 further comprising a locking system that provides direct and consistent locking of the return funnel to the return trough orientation for operating conditions.

[45] The apparatus of claim 44 further comprising a system for opening the return funnels away from the nozzles and return trough to permit clearance for rotation of the nozzle or hozzles for cleaning or to use an alternate nozzle configuration.

[46] The apparatus of claim 45 further comprising a system for holding the return funnels into proper production orientation while the return funnels are open and the nozzles are being rotated for cleaning or to use an alternate nozzle configuration.

[47] An apparatus comprising:

one or more elongated nozzles consisting of a leading edge, a metering surface and end seals having an elongated opening that deposits coating to an application surface;

a cleaning shell for closing onto and cleaning an off-line nozzle;

a locking system that repeat ably and accurately maintains proper orientation to the off-line nozzle regardless of on-line nozzle position.